

7.

Crabs of the Genus *Uca* from Venezuela.¹

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(Plate I; Text-figure 1).

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I. INTRODUCTION.

The present study is based on 1,049 specimens of *Uca* collected on the Venezuelan Expedition of the Department of Tropical Research of the New York Zoological Society, under the direction of Dr. William Beebe. The expedition extended from February to September, 1942, with headquarters at Caripito, in northeastern Venezuela.

The specimens are distributed among five species, of which two are apparently new to science, and were taken in four general localities: the Caripito region of the San

Juan River; the swamp near the mouth of the San Juan; the Pedernales region at the mouth of the Caño Manamo at the southern end of the Gulf of Paria; and the Maracaibo region, in western Venezuela. For the excellent and extensive collection made at Maracaibo, I wish to express my thanks to Mr. Henry Fleming, the expedition's entomologist, who collected the material for me during a week's stopover in that locality. During the course of collecting the remainder of the crabs, I was able to make a number of ecological observations, which are incorporated in the present report, including the displays of four of the five species taken.

For general working methods, and for definitions of measurements and special terms, refer to Crane, 1941, p. 148. The making of a series of 16 mm. color motion pictures of displaying fiddlers at Pedernales was the only new addition to the working procedure. Detailed drawings of abdominal appendages are presented, since the genital organs are proving, in this as in other groups of animals, to be of definite aid in taxonomy; more work needs to be done, however, before basic structural plans and their evolutionary significance can be adequately described and evaluated.

Miss Rathbun's synonymy (1917) has been accepted throughout, except in regard to *U. mordax* (see p. 38).

II. ECOLOGY.

Habitat: All of the crabs were taken from slightly brackish river banks and delta shores. Although each locality was under tidal influence, the salinity in all cases was very low. The majority were collected during the rainy season in the summer months, so that the salinity was at its minimum. Adequate series of salinometer readings were not made, but Table I will give a general idea of conditions.

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TABLE I.

Place	Date	Season	Tide	Salinity (cf. with normal sea water)
Caripito	Apr. 10	Dry	2 hrs. after high	0.6%
Near mouth San Juan R., 8 miles above bar	Apr. 10	Dry	High	1.2%
Pedernales	Aug. 25	Rainy	High	.23%
Pedernales	Aug. 26	Rainy	1 hr. after low	1.2% ²
Maracaibo, Yacht Club	Sept. 7	Rainy	High	2.0%

In spite of these relatively small differences, the five species taken group themselves definitely into a series, the proportions shifting from river to near river mouth to Maracaibo mud flats in a way that cannot be wholly accounted for by changes in vegetation, soil or amount of light, since in these respects certain stations in each of various localities were very similar. The occurrences of the crabs may be tabulated as in Table II.

The second habitat (near the river mouth) was collected only during a two-hour period on a single day at one spot, in deep shade,

(both in the semi-shade of mangroves and on the open flats) around Maracaibo, *mordax* was completely absent while *pugnax rapax* was far and away the dominant form. Of 526 specimens of *Uca* collected by Mr. Fleming at Maracaibo from five different stations, giving as varied habitats as possible, all except 15 were *pugnax rapax*, the remainder being *murifecunda*, the proposed new species taken also near the mouth of the San Juan and at Pedernales.

At Pedernales, the only locality where all five species were taken, the preferences for

TABLE II.

	<i>mordax</i>	<i>pugnax rapax</i>	<i>murifecunda</i>	<i>cumulanta</i>	<i>maracoani</i>
River: Minimum salinity; mangroves rare: Caripito, Guanoco.	Dominant	—	—	—	—
Near river mouth: mangroves dominant: San Juan R., 8 miles above bar.	yg. only (April)	Rare	Dominant	—	—
Lower delta swamp: mangroves and marsh grass only: Pedernales, at mouth of Caño Manamo.	Abundant	Common	Rare	Abundant	Common
Tidal flats: mangroves adjacent or distant; marsh grass sometimes present: Maracaibo.	—	Dominant	Rare	—	—

back from the banks, among the highest mangroves; hence the results obtained there would doubtless be considerably modified by more extended collecting in the vicinity.

The other regions, however, were extensively collected, and although additional species would almost certainly be added by exhaustive collecting over a protracted period, the relative abundance indicated by the table would doubtless in general hold true. The major fact appearing is that up rivers, toward the limit of the *Uca* range, only *U. mordax* occurs, but that it is here extremely successful; all along the banks of the upper San Juan and its tributaries, and many yards back in the adjacent swampy land, *mordax* was exceedingly abundant, the colonies often lining the banks in practically unbroken series. At the opposite end of the brackish water habitat, on the tidal flats

particular habitats could be best compared. Here the differences noted in Table III were obvious, and these observations tallied with preferred habitats in the other localities.

Size: No statistical work has been done as yet, but it is interesting to note that adult *pugnax rapax* taken at Maracaibo from the No. 2 type of habitat—i.e., from close to or among mangroves—were on the average definitely larger than those from the barren mud and sandy-mud flats in the same neighborhood.

Breeding: Apparently in Venezuela the main breeding season is in the spring. *U. mordax* at Caripito was displaying vigorously from February throughout April, and ovigerous females were seen at this time. Between May and September there was progressively less waving seen, and by late summer it appeared to have practically died out, although during the third week in August, at Pedernales, it was continuing in desultory fashion. The season of *pugnax*

² The apparently contradictory results obtained at Pedernales, where the salinity near low tide was almost six times more than at a high tide near full moon, is doubtless due to the erratic currents in the neighborhood.

TABLE III.

Key					
	X, Preferred				
	X, Present				
	—, Absent				
1. Deep shade, among mangroves	X	—	X	—	—
2. Open sunny, or semi-sunny, mud patches among mangroves and/or grass tufts	X	X	X	X	—
3. Open mud flats	X	X	—	X	X
4. Open mud flats with surface layer of sand, or sand and pebbles	X	X	—	X	X

rapax apparently corresponds exactly to that of *mordax*. The full breeding season of *murifecenta*, judging by the proportion of ovigerous females, occurred in April; no ovigerous examples were taken at the other localities where it occurred, in August and September. No ovigerous females of either *maracoani* or *cumulanta*, collected only at Pedernales in late August, were found, although the males were displaying vigorously compared to those of other species, and the females showed response, especially in *cumulanta*; in *maracoani* the final stages of courtship and response were not observed.

III. PHYLOGENETIC NOTES.

It is not possible at this time to analyze the relationships of western Atlantic *Ucas* as was done in the case of the eastern Pacific forms (Crane, 1941), and consolidate the two studies, but the present collection does shed further light on this general problem.

In the first place, the conclusions reached in that paper, in regard both to the divisions of the fiddler crabs into phylogenetic groups (*loc. cit.*, p. 165) and to the relationships of these species traceable through courtship displays as well as physical characteristics, are corroborated and extended. The coloration and display of *maracoani* fitted in with those previously observed on the Pacific coast among others in Group 1, while the rapping phase of display in *cumulanta*, the proposed new species referable to Group 4, had as obvious affinities in display to members of that group in the Pacific as it did in its physical attributes; in addition, *cumulanta* built shelters similar to those made by *beebei*, *latimanus* and *terpsichores* in Group 5.

The remaining three species of the Venezuelan collection, *mordax*, *pugnax rapax* and *murifecenta*, all belong to Group 2, and were of special interest since I had not previously had an opportunity of observing the display of members of this group. The new species, *murifecenta*, was not seen waving,

but in both of the other species the main display characteristics consisted of a series of three to five jerks with the major cheliped, accompanied or followed by kicking out and vibration of two or more ambulatories. Also, both displays were exceptionally slow and deliberate, and no brilliant or even striking colors were assumed, general lightening of the carapace, and the assumption of dull ochres or oranges on the major cheliped being the maximum change. Both the slowness and the dullness are in contrast to the display characteristics of the more highly developed species of the other groups, and lends additional evidence to the theory already proposed (*loc. cit.*, p. 166) that members of Group 2 are relatively primitive. Another interesting point is that they fail to clean more than their eyes, frontal region and chelae of mud before displaying, in great contrast especially to the end members of other groups. A final observation in regard to this group is that its members appear much more subject to individual variation than do those of the others.

Some adult females of both *mordax* and *murifecenta* were observed to have walls about their holes similar to those occasionally made by the females of *stenodactyla* (*loc. cit.*, p. 196), but the males built no shelters of the type made by *minax* in the north (which are quite different from the hood-like forms built by *cumulanta* and members of Group 5). The entire question of shelter-building still remains one of the most puzzling problems to be solved in connection with these crabs.

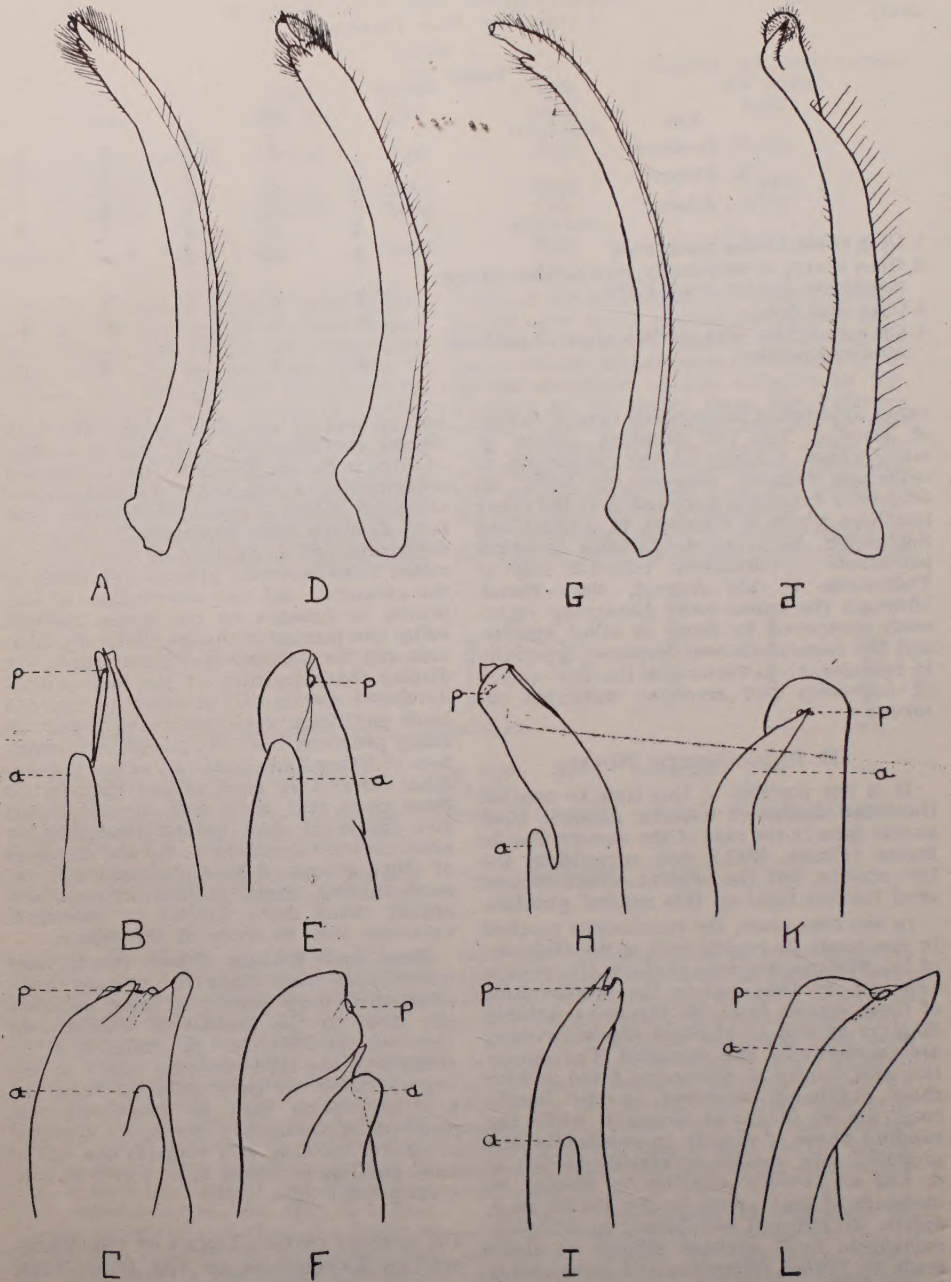
IV. SPECIES OF *Uca* TAKEN BY THE VENEZUELAN EXPEDITION OF THE NEW YORK ZOOLOGICAL SOCIETY.

Uca maracoani (Latreille, 1802-1803).

Text-fig. 1J,K,L,

References: *Ocypode maracoani* Latreille, 1802-1803, p. 46.

Uca maracoani, Rathbun, 1917, p. 378; pl. 130, figs. 2, 3; pl. 131, fig. 3.



Text-fig. 1. Right abdominal appendages of adult males in *Uca*. **A**, *pugnax rapax*, outer lateral view; **B**, same, tip, outer lateral view; **C**, same, tip, anterior view; **D**, *murifecenta*, outer lateral view; **E**, same, tip, outer lateral view; **F**, same, tip, anterior view; **G**, *cumulanta*, outer lateral view; **H**, same, tip, outer lateral view; **I**, same, tip, anterior view; **J**, *maracoani*, outer lateral view; **K**, same tip, outer lateral view; **L**, same, tip, anterior view. **p**: genital opening; **a**: arm. (Exact numbers of hairs not shown in full-length views, although apparent proportions and exact locations are indicated; hairs omitted from drawings of tips).

Range: Previously known between Cayenne, French Guiana, and Rio de Janeiro, and, by Sloane's record, from Jamaica. The present record extends the range to eastern Venezuela.

Local Distribution: Found on open tidal sandy mud shores in river deltas; water slightly brackish.

Supplementary Specific Characters: Abdominal appendage of male slender and tapering, save for a slight subterminal constriction at the beginning of the strongly curved distal portion. Subterminal arm strongly chitinized, spinous, crossing in front of densely haired tip. Female with moderate-sized tubercle on external side of genital opening. Spooned hairs on merus of external maxillipeds with the strong basal spine typical of species in Group 1, but with pectinations better developed than usual in this group.

Measurements: The 18 specimens taken include the following extremes of length: largest male, 18 mm.; largest female (immature) 13 mm.; smallest male, 9 mm.; smallest female, 6.3 mm.

Color: Displaying males observed through binoculars: Carapace dull grayish-purple, never free from mud, except on frontal region and behind eyes. Anterior margins of eyebrows scarlet orange. Major cheliped: merus, carpus and base of manus grayish-brown, shading distally into dull orange; pollex scarlet orange; dactyl, outer side, purplish-orange to scarlet orange; dactyl, inner side, usually iridescent purple with orange reflections. Minor manus and chelae scarlet orange. Mani or all ambulatories dull scarlet orange. Subocular and pterygostomian regions bright purple. Immature males with major pollex and dactyl orange without scarlet tinge. Females plain brown.

Display: At beginning of display all ambulatories are stretched upward, elevating body. Major and minor chelipeds start from position folded in front of mouth, at mouth level. The manus and chelae of both chelipeds are then extended upward and outward, with fingers kept extended throughout, and brought down into position. With each gesture the second ambulatory, the second and third, or the third only on the minor side, and, usually the first and second on the major side are lifted from the ground and spread sideways. During display a few steps are usually taken, either side-wise or in a circle, the crab facing outward. Each display lasts about three-quarters of a second, and the next in the series follows almost at once. One day, shortly before high tide, I noticed a great deal of apparently aimless racing about on the part of these crabs; no females were visible as special stimulus, as in the case of *U. stenodactyla* (Crane, 1941, p. 196).

Males were displaying fairly continuously between August 23 and 27, the only period of observation, and showed interest in females; final stages of courtship were not seen, however, nor were ovigerous females taken.

Material: A total of 18 specimens was taken at Pedernales, Venezuela (Cat. No. 42414).

Uca mordax (Smith, 1870).

References: *Gelasimus mordax* Smith, 1870, p. 135, pl. 2, fig. 3; pl. 4, figs. 4 and 4a.

Uca mordax, Rathbun, 1917, p. 391, text-fig. 166, pl. 134, figs. 3 and 4. (*Partim*: not Pacific specimens).

Not *Uca mordax*, Crane, 1941, p. 176, text-figs. 2, 3, 4e.

Range: From the Bahamas and Gulf of Mexico to Rio de Janeiro.

Local Distribution: Found among mangrove roots and mucka mucka, preferably not in deep shade, and on the open muddy banks of slightly brackish streams. Sometimes they live in moist, muddy ground many yards back from the river edge, in areas inundated only at spring tides. This is the typical, abundant fiddler of the banks of rivers well above their mouths and of the upper delta areas.

Supplementary Specific Characters: Spoon-tipped hairs on merus of second maxilliped almost or completely lacking; woolly hairs moderate in number. Ischium of third maxilliped with central groove very broad, shallow, parallel to inner groove, with which it tends to merge basally, although it is scarcely traceable so far.

Minor chelae about as long as palm with fairly strong serrations in middle third; distal third horny, dilated, the tips articulating perfectly; gape slight, extending to articulation. Hairs moderately well developed, even in large specimens, both distally and in the usual inner oblique rows; there are in addition a few forming an external row.

Suborbital region hairy.

Abdominal appendage of male slender, with a short arm projecting from it at an acute angle (Crane, 1943, p. 32, text-fig. 1A, B, C.). Gonopore of female without tubercle, or with at most a rudimentary marginal swelling.

Measurements: The 246 specimens taken include the following extremes of length: largest male, 15.5 mm.; largest female 14.5 mm.; ovigerous females, 8.4 to 12.5 mm.; smallest male, 2.5 mm.; smallest female, 2 mm.

Color: Displaying males: Carapace varying from slaty through yellowish-gray to whitish. Manus of major cheliped usually faintly yellowish; fingers of both major and minor chelipeds creamy white. Front of all

ambulatories pale bluish in some of the specimens taken around Caripito; legs otherwise brownish. Since these crabs appear never to clean more than their eyes and the fingers of both chelipeds, the colors are much dimmer than would otherwise be the case. Females and young brownish. There is never the least trace of the spots, in either living or dead specimens, which are so characteristic of *U. schmitti*, the homologous Pacific form.

Display: The carapace is elevated on legs stretched up to tiptoe, chelae held high, crooked in front of mouth. Major cheliped is raised upward in three or four jerks, which are immediately followed by three or four jerks down, without pause at the peak, and with scarcely any pause afterward, between displays in a single series. One or two ambulatories of either or both sides are raised and kicked outward at peak of display. Both major and minor chelae are kept ajar during the entire period, and during each display the minor cheliped makes a circular gesture corresponding to that of the major. When possible, some small eminence is chosen for display, the crab sometimes moving a few steps in either direction during display, but apparently never revolving. About five seconds is the average time required for a single display, although when the crab is much excited by a female, it may be much faster, even as much as two to the second. In the latter case, there may be long waits between displays, in which the crab poses motionless with the major cheliped held overhead. The height of the courtship excitement seems to be indicated by the completion of the display with rapid vibrations of the third, or second and third, ambulatories on each side, after their kicking routine.

One male, with the major cheliped abnormally regenerated, with exceedingly small, crooked chelae, displayed vigorously, but the waving consisted of repeated circular motions with the cheliped held aloft, and with the characteristic jerking absent. This crab was not observed to arouse any interest among nearby females.

Breeding: The faster, more complex displays described in the paragraph before the last were seen only at Caripito, between February and April, and not at Pedernales in August, when the breeding season was definitely waning and only a few males displaying. During several days' concentrated collecting in this locality, only four ovigerous females of this species were taken; at Caripito in the spring they were relatively much more numerous. One of these Pedernales ovigerous females had her hole surrounded by a three-inch wall of pellets. The eggs, which measure .51 mm. in diameter after having been preserved in alcohol, number

between about 3,000 and 10,000, depending on the size of the crab. Near the mouth of the San Juan river in April only young, none more than 10.5 mm. long and the majority much smaller, were taken. It may be that they are not established here, for undetermined reasons, but that young get washed down from the great colonies further up-river.

Discussion: The Pacific crabs referred by me to this species in 1941 (p. 176), as well as those in the Museum of Comparative Zoology and at the U. S. National Museum (No. 22,306) referred to it by Rathbun (1917, p. 393), form the basis of a new, homologous species. Its description, along with the differences separating it from *U. mordax*, have been published in the paper immediately preceding this one (Crane, 1943, p. 31).

The present Venezuelan collection of *mordax* is typical of the species. There is some variation in the ornamentation of the palm, but most of this is due to age; in the young the tubercles in many specimens are relatively smaller, while in the very old they are sometimes almost lacking on the oblique ridge. There are also small variations in the width and shape of the front of the carapace. None of these variations, however, can be shown to depend on geographical location, or on local habitat.

The females of *mordax* are easily distinguished from those of *pugnax rapax*, which sometimes approach each other in width of front in this sex, by the total absence or extremely rudimentary condition of the tubercle at the genital opening. An examination of the Liberian female (U.S.N.M. No. 21847), referred questionably to this species by Miss Rathbun (1917, p. 393), has convinced me that it cannot be *U. mordax*: although it is small (7.9 mm. in length), it appears adult and has a well developed genital tubercle. In addition, the orbits are less slanting than in female *mordax* of similar size, and there is less pile on the ambulatories.

Material: A total of 246 specimens was taken in the San Juan River (at Caripito, Cat. no. 4252; Guanoco, Cat. no. 4254; and near its mouth, 8 miles above the bar, Cat. no. 42166); and at the mouth of the Caño Manamo (at Pedernales, Cotorra Island and Tapure), Cat. no. 42415.

Uca murifecenta sp. nov.

Pl. I, Figs. 1-3; Text-figs. 1D,E,F.

Diagnosis: Carapace moderately convex with conspicuous patches and reticulations of pile; front behind eyes broad and shallow, but considerably less than one-third width of carapace; orbits little oblique; antero-lateral margins convex, curving gradually backward; minor chelae about as long as palm,

with fairly strong serrations in middle third, gape moderate, decreasing distally to perfectly articulating tips. Major palm with oblique ridge poorly developed, covered with band of low, small tubercles, only reaching carpal cavity; rows of tubercles at base of dactyl diverging and inner surface of palm granulate, as in *mordax*. Merus of ambulatories slightly enlarged in male, more so in female. Spoon-tipped hairs absent on merus of second maxillipeds. Suborbital region partly naked.

Description: A moderately small species. H-form depression shallow, but marked with pile; additional patches and reticulations of pile on hepatic and branchial regions, and sometimes on protogastric and mesogastric as well; surface of carapace otherwise smooth. Pile also present on upper surface of all segments of ambulatories; rare on under surface of manii as well in male, but rudimentary in female. In addition, the ambulatorial manii and carpi in the male have a number of conspicuous long, soft hairs.

Carapace moderately convex, widest behind antero-lateral angles. Upper margin of orbit scarcely oblique. Anterior part of lateral margins convex and curving gradually backward; the margin thereafter curving sinuously inward, ending at a point opposite middle of cardiac region. Front between posterior margins of eyestalks about midway between one-fourth and one-third maximum width of carapace, very shallow, almost truncate. Lower margins of both front and orbit visible in dorsal view. Eyebrow moderately narrow, steeply inclined. Lower margin of orbit with crenulations poorly developed, concealed by hair and pile. Suborbital region with general, thin, delicate covering of pile, easily dislodged, and an anterior marginal band of hairs. Segments of male abdomen distinct.

Spoon-tipped hairs on merus of second maxilliped absent. Woolly hairs plentiful. Ischium of third maxilliped with shallow central groove well developed except in a few large specimens, almost confluent with inner groove basally.

Minor chelae with moderately strong serrations in middle third; distal third corneous, dilated, the tips articulating perfectly; gape slight to moderate, decreasing steadily to the articulation.

Hairs in an irregular oblique row across inner and outer surfaces of each finger, scanty except for an internal and external tuft distally.

Large cheliped of male with arm rugose, with pile between rugosities. Wrist weakly tuberculate, with a row of about four low teeth on upper margin; a patch of pile on upper outer surface, covered by manus in flexion of cheliped. Hand less than one and a half times longer than wide with rows of

low tubercles—double or triple above, single below—forming low carinas on upper and lower margins. Close-set, low, moderate-sized tubercles covering outer upper surface; but so low and small on lower half that surface appears smooth. Inner face with oblique ridge low and weak, covered with a band of tubercles, not set in definite rows and stopping at carpal cavity in a cluster of several large tubercles. Upper margins of carpal cavity marked by a ridge of coalesced granules. A row of well developed tubercles extends from proximal part of upper margin of pollex obliquely up and back across distal part of palm, dying out well below dorsal margin. Space between this ridge and carpal cavity filled with strong, low tubercles, leaving smooth only the concave area just below dorsal margin and the similar concave space at base of pollex. A short row of several small tubercles parallels base of dactyl. Dactyl almost one-third longer than palm, tuberculated dorsally in proximal region, curving strongly downward beyond tip of pollex. Latter more slender than dactyl, tapering. Gape moderate. Many low, blunt teeth on each finger; about four enlarged ones scattered at intervals on dactyl, the largest being less than one-third the distance to top; pollex with one enlarged tooth about midway to its tip, and one at extreme tip; in addition a pair, beyond this, are directed distally, at right angles to the normal teeth.

Merus of ambulatory slightly enlarged in males, considerably in females; that of third leg extends about a fifth of its length beyond antero-lateral angle when laid forward.

Abdominal appendage of male thick, scarcely tapering, with a thick, subterminal arm paralleling it, not protruding laterally. Genital opening of female marked by a large tubercle.

Measurements: Male holotype, length 14.5 mm., breadth 20.5 mm., base of manus to tip of pollex 32 mm.; 5 male paratypes, lengths 11 to 12.5 mm.; 5 ovigerous female paratypes, lengths 8.2 to 13.5 mm.; 1 non-ovigerous female paratype, length 13.5 mm.; largest male, length 15.6 mm.; smallest male, length 6.9 mm.; smallest female, length 6.9 mm. In addition to the above, 41 males, 3 ovigerous females and 17 non-ovigerous females of intermediate lengths were taken.

Color: Brightest males, free, but not displaying: Dull rusty orange above, with major manus and chelae moderately bright lemon yellow. Brightest females dull rusty orange above, rest of body and legs brownish. Most crabs of both sexes, however, were dull brownish. The majority of those captured turned from brown to faintly rusty in the refrigerator over night. Eggs magenta.

Walled Holes: Large crabs, including the brightest specimens of both sexes, were seen resting on top of, or partially leaning on,

the broad flanged wall surrounding the mouth of some of the holes. The majority of these walled holes seemed to belong to large females, often ovigerous. The largest structures were $2\frac{1}{2}$ inches high by 2 inches across the widest part, those of smaller crabs being in proportion. A number of pairs of contiguous turrets were seen, a large male and female in each pair. Turrets were built of pellets large in proportion to the crab, up to 5 mm. across. Compared to the numbers of this species, which was dominant near the mouth of the San Juan, turrets were few in number.

Breeding: Ovigerous females were common near the mouth of the San Juan River on April 10. The males were not seen displaying, although this may have been solely due to the fact that there was no opportunity for quiet, undisturbed observation. No very young crabs were taken here, and no ovigerous specimens were taken at Pedernales and Maracaibo, in August and September, the other localities where the species was collected. The eggs of San Juan specimens, which measure .51 mm. in diameter after having been preserved in alcohol, number between about 3,200 and 7,000.

Affinities: *U. murifecenta* belongs in the broad-fronted group of crabs having the antero-lateral margins curving gradually backward, and few or no spoon-tipped hairs on the merus of the second maxilliped, and described under the general designation of Group 2 in a previous paper (Crane, 1941, p. 166); it includes *pugnax*, *mordax*, *brevifrons*, etc. The present proposed species is probably most closely related to *mordax*, resembling it closely in the general shape of body and cheliped, and in the ornamentation of the major manus. It differs, however, in the presence of pile on the carapace, in the much weaker, sometimes obsolescent, oblique ridge inside the manus, with the tubercles considerably finer; in the more truncate, narrower front, in the shape of the abdominal appendage of the male, and in the presence of a large tubercle beside the genital opening in the female. The ornamentation inside the manus, with the reduced ridge covered by granules or tubercles which tend often to run into those between the carpal cavity and the diverging ridges at base of pollex and dactyl, resembles also that of *pugnax*. As a field character, the presence of pile is excellent, since it is present in none of the other related species hitherto described. Although pile is much less abundant on the females than on the males, and in general somewhat less plentiful on the Maracaibo specimens than on those from eastern Venezuela, still, when looked for, it is unmistakably distinct.

Local Distribution: Near the mouth of the San Juan River, the only locality where this

species was abundant (here it was dominant), it lived in the shade of tall (75-foot) mangroves and six-foot ferns, from fifteen feet to many yards back from the river bank. This locality was not visited at extreme high tide, but it seems certain that it is inundated only at spring tides; an hour before an ordinary high tide, however, the water came to within one foot of the surface one hundred and fifty feet from shore; hence the surface, always in deep shade, never really dries out even in April, the end of the dry season. At Pedernales the species was taken in similar shady, muddy regions among mangroves. In Maracaibo a few were taken on flats shaded only by tussocks of marsh grass. The salinity in each of these localities is low, but the absence of the species from the San Juan up at Caripito indicates that it cannot stand water as fresh as does *mordax*.

Material: A total of 76 specimens, including the male holotype five male paratypes and six female paratypes was taken in Venezuela near the mouth of the San Juan River, 8 miles above the bar (57 specimens, including the type series); from Pedernales (3 specimens); and from Maracaibo (16 specimens). Cat. nos. 42167 (holotype), 42417 (paratypes), 42418 (remaining specimens from San Juan), 42416 (Pedernales) and 42419 (Maracaibo).

The name *murifecenta* is given to this species in reference to its habit of making walls.

Uca pugnax rapax (Smith, 1870).

Text-figs. 1A,B,C.

References: *Gelastinus rapax* Smith, 1870, p. 134, pl. 2, fig. 2; pl. 4, fig. 3.

Uca pugnax rapax, Rathbun, 1902, p. 7; 1917, p. 397, pl. 140.

Range: From Miami, Florida and the Gulf of Mexico to Rio de Janeiro.

Local Distribution: Tidal salt marshes, often with sandy or pebbly upper layer over the usual muddy substratum, either bare and open, or among tussocks of marsh grass; sandy mud shores of bays and river mouths; sometimes in shade among mangroves with *mordax*, but in general requires saltier water than the latter, although their ranges overlap. See Oliveira, 1939, for a detailed analysis of a typical habitat in Brazil.

Supplementary Specific Characters: Spoon-tipped hairs on merus of second maxilliped moderate in number, strongly developed, but variable, usually between about 70 and 120; two groups of specimens, otherwise indistinguishable from the rest, from near the mouth of the San Juan among mangroves and from a single muddy shore with grass tussocks in the Pedernales region, had the spoon-tipped hairs fewer in number than others of similar size—as few

as 25—and the spoon tips themselves more elongate and delicate; these groups were taken in the two most shady locations where the species occurred. Woolly hairs moderate in number. Ischium of third maxilliped with central groove very broad, shallow, parallel to inner groove with which it tends to merge basally, although it is scarcely traceable so far.

Minor chelae as in *mordax*. Suborbital region mostly naked except for an anterior border of hair and pile.

Abdominal appendage of male thick, scarcely tapering, with a thick, short, distal arm paralleling it, not protruding laterally. Genital opening of female marked by a moderate-sized tubercle, sometimes reduced in ovigerous specimens.

Front of male appears slightly deeper and more tapering, therefore narrower, than that of female. In details of shape of carapace and ornamentation of cheliped, this species is variable, as usual in Group 2 species (see page 00).

Measurements: The 645 specimens taken include the following extremes of length: largest male, 18 mm.; largest female, 15 mm.; ovigerous females, 8.06 to 14.5 mm.; smallest male, 3.55 mm.; smallest female, 4.9 mm.

Color: Displaying males (observed at Pedernales only): Carapace grayish-white to buffy yellow, brightest on front; no part of it except front ever really free from mud. Underparts duller. Major cheliped—merus, carpus and basal half of manus—brownish, changing on distal half of manus to moderately bright apricot buff. Distal to this both fingers are light apricot orange fading distally to creamy white. Manus and fingers of minor cheliped creamy white, rest of it and all ambulatories brownish, never cleaned of mud in displaying. One male had patches of bright green algae on upper outer side of major merus and upper outer sides of manus of all ambulatories. Females and non-displaying males, observed at Pedernales and near mouth of San Juan River, dull brownish, faintly spotted.

Display: In full display this crab, although the movements are relatively slow compared with more marine forms, is exceptionally dramatic: The display starts with body elevated on extreme tiptoe, chelae held flexed in front of mouth, well above ground. Major cheliped is raised upward in three jerks, held at topmost stretch so that accent of display is here, held for a dramatic instant, and then swung smoothly and swiftly obliquely down to the flexed starting point. When the crab is not displaying strongly, however, or when apparently tired toward the end of a long series, there are sometimes one or two small jerks on the end of the downward stroke. In any case, the

display is at once repeated, without pause. Fingers of major cheliped are opened in each display; those of minor stay open throughout. During display any one or two ambulatories on both sides (including rarely the fourth, at least on major side) may be lifted and kicked outward at peak of display. The crab may move a few steps, usually toward major side, or hold still, but does not revolve. There are up to at least 20 displays in each series. Only the eyes, front, chelae and part of the major manus are kept clean, but these are always immaculate before display begins. About six seconds are required for each display: three to five in the elevation of the cheliped, one in the pause at the apex, and one-half a second on the way down.

Breeding: Three of the four ovigerous females were taken in April near the mouth of the San Juan River, and measure between 8.06 and 10.5 mm. Only four other females were taken in this station. The fourth ovigerous specimen, 14.5 mm. long, was taken at Pedernales the third week in August, the only ovigerous female among a total of 36 females collected from this locality. The first week in September not one of 70 females collected at Maracaibo carried eggs. Hence a spring breeding season is indicated in Venezuela. There was opportunity for observing display only at Pedernales in August; here it was desultory or completely lacking in most adults, strong in very few. The eggs, preserved in alcohol, measure .51 mm. in diameter, and number between about 1,800 and 19,000.

Discussion: In shape of front and anterolateral margins as well as in details of ornamentation of the inside of the manus, and development of teeth on fingers, this form is somewhat variable, as Rathbun has already noted, and as is true also of other species in this group (*U. mordax*, etc.). I can detect no geographical distinctions, however, which would justify making further specific or subspecific distinctions. The most interesting result of this large collection is the observation that in general the specimens taken on sandy-mud superstratum over mud, in the open sunlight but with vegetation nearby, grow to larger size than those either in adjacent deeply shaded stations, or in open localities far removed from vegetation. This problem has not, however, been studied statistically. As has been noted, in the two shadiest, muddiest collecting areas the spoon-tipped hairs were relatively poorly developed.

Material: A total of 645 specimens was taken near the mouth of the San Juan River 8 miles above the bar (Cat. no. 42168), at the mouth of the Caño Manamo (at Pedernales, Cotorra Island and Tapure, Cat. no. 42420), and from Maracaibo, from five col-

lecting stations between the Yacht Club and a point three or four miles to the north (Cat. nos. 42,421, 42422, 42426, 42427).

Uca cumulanta sp. nov.

Pl. I, Figs. 4-6; Text-figs. 1G,H,I.

Diagnosis: Carapace strongly convex, but not quite semi-cylindrical in lateral view; front behind eyes a little more than a fifth maximum width of carapace; orbits little oblique; antero-lateral margins well developed, straight or slanting slightly outward (rarely inward); then continuing backward and inward with an angular turn; orbital angle usually a right angle, sometimes slightly produced; minor chelae strongly serrated in middle three-fifths; gape slight; hairs on chelae moderately plentiful. Oblique tuberculated ridge inside major palm present, continued to upper margin and strong throughout, with the single row of tubercles splaying out distally into a small irregular patch. Pollex moderately slender with a small, serrated elevation halfway to its tip, and usually one or more enlarged teeth distal to this. Merus of second maxilliped with not more than 25 spoon-tipped hairs. Merus of ambulatories moderately enlarged in male and female. Small patches of pile, inconstant in amount and location, present on carapace. Arm on abdominal appendage of male short but well developed. Eyebrow broad, little inclined.

Description: A small species. Carapace with H-form depression distinct, but regions otherwise poorly defined, naked except for small patches of scanty pile present in any or all of following locations: in upper half of H-upright (most constant and plentiful here), in entire H-form depression, in depression between hepatic, orbital and antero-lateral margins, and in mid-branchial depressions. In addition there are a few widely scattered microscopic hairs in carapace surface.

Carapace strongly convex, but not semi-cylindrical in lateral view, widest usually behind orbital margins. Latter are well developed, straight, usually slanting a little outward, rarely faintly inward, about four-fifths as long as width of front behind eyes. They then turn inward and backward at an angle, continuing in the form of the usual ridge as far as middle of cardiac region. Sides of carapace slightly concave, little converging. Front between posterior margins of eyestalks about a fifth width of carapace, its margin visible in dorsal view. Upper margin of orbit sinuous, scarcely oblique. Eyebrow broad, equal in width to adjacent portion of eyestalk, little inclined. Lower orbital margin moderately projecting with crenulations weak internally, strong externally. Suborbital region naked except for a

row of hairs immediately behind orbital margin. All abdominal segments distinct.

Spoon-tipped hairs on merus of second maxilliped few, about 15 to 25 or less, poorly developed. Woolly hairs moderately plentiful. Ischium of third maxilliped with central grooves represented only by a marginal depression.

Minor chelae about one and one-fifth times longer than palm, with strong serrations throughout middle three-fifths; distal fifth corneous, slightly dilated, the tips articulating well. Gape very slight. An oblique row of long, soft hairs (longest distally as usual), and a straight row of wide-set short hairs on inner surface of each chela; two rows of short hairs, most set in series of three on their external surfaces, and two other similar rows along dorsal profile of dactyl and ventral of pollex respectively.

Major cheliped of male with arm only slightly rugose except on upper distal surface, wrists somewhat rougher. Both furnished externally with small, variable amounts of pile. Hand at most about four-fifths as broad as long. Upper surface rounded, except for a slightly elevated double line of fine granules; lower margin with a single line of similar ones; upper and outer surfaces with low, small tubercles; lower practically smooth.

Inner surface of major palm with pile on proximal articulating surface of carpal cavity. A strong oblique tuberculated ridge arising some distance proximal to base of pollex, proceeding obliquely up and back to carpal cavity, then following margin of latter almost to dorsal profile. Tubercles of uppermost portion, although large and strongly developed, splay out into an irregular double or triple formation. Carpal eminence well developed. A row of tubercles extends from proximal tenth of pollex, close to upper margin, obliquely back and up along distal part of manus, where the tubercles are large and close-set, the last tubercles approaching uppermost ones of main oblique ridge. Distal to this, paralleling base of dactyl, is a row of about five, smaller, close-set tubercles.

Major dactyl about one and a third times as long as palm, moderately convex, curving down beyond tip of pollex. Pollex slender, not triangular, with a small serrated elevation, of which distal tooth is enlarged, halfway to its tip, and at least one considerably enlarged tooth distal to this. The dactyl has only one tooth strikingly enlarged, located at about middle of its length. Gape wide. A row of close-set tubercles arising on outer side of distal end of manus continues out along upper surface of pollex, close to prehensile margin, to its tip. A corresponding row is traceable almost the entire length of the dactyl.

Merus of ambulatories moderately en-

larged in both sexes, that of third ambulatory in male usually extending scarcely beyond antero-lateral margin when laid forward. Pile on ambulatories practically lacking.

Abdominal appendage of male slender, curving, tapering. Subterminal arm short but well developed, arising at beginning of distal seventh of appendage. Genital opening of female set in a depression, without marginal tubercle.

Measurements: Male holotype, length 8.4 mm., breadth 13.9 mm., base of manus to tip of pollex 24.5 mm.; seven male paratypes, length 6.3 to 7.8 mm.; six female paratypes, length 6.9 to 8.4 mm.; smallest male, length 4.4 mm.; smallest female, length 4.8 mm.; 29 additional males and 19 additional females of intermediate lengths.

Color: Displaying males observed through binoculars: carapace (rarely free of mud except anteriorly) iridescent green, marbled and mottled at least posteriorly with dark brownish and grayish-white. Major cheliped dull grayish or brown except chelae: dactyl has rosy tinge on upper basal part; both chelae otherwise white or yellowish except for extreme tips which may be pale peach, or the fingers may be apricot at base, white distally. Legs grayish, banded light and dark. Females dull brownish.

Display: This is a simple beckoning routine which starts with the crab moderately elevated and with the cheliped flexed in front of the mouth and held clear of ground. Display is of moderate speed, at the rate of about one to the second, but with a long pause, of two seconds or more, between displays in the same series, except when the crab is waving with especial vigor, usually when the attention of a female has been attracted. Then, at the end of most of the beckonings or wavings, several vibrations pass along the major cheliped, the muscular movement taking place in the merus and above. The ground is not actually touched with the manus and pollex, as in other species of this rapper group, except at moments of the greatest excitement. One male was seen to reach the stroking stage of courtship with two females in quick succession, each of which rejected him and escaped. Finally still another female did follow a second male into his hole. Neither of these males had a shelter (see next paragraph). When I first saw the apparently successful male, the female was two inches away and watching him; he was finishing a routine display; as the female started toward him, he went halfway down his hole, rapping the manus and carpus of the major cheliped three or four times hard against the hole's edge, then vanished. The female came over at once, looked down, then went two inches beyond the far side of hole, and waited. In

about a minute the male reemerged, looked around, dashed straight to the top of a small mound two inches from the opposite side of the hole from the female, and displayed vigorously, with rapping, just once. Thereupon the female suddenly dashed down his hole and he ran back and followed her down at once. Since the tide was coming in rapidly and I needed the crabs for identification, I secured them after another five minutes. A similar procedure was observed between a male with a well-built shelter and another female. One crab—and only one—was seen again and again to climb upon his shelter to display.

Shelter: As with shelter-builders of Group 5 observed in Panama, it was found that only displaying males, but not all of these, built shelters. In this species the shelter, although in general form a half-dome as in Group 5, is roughly made, very variable, and always exceedingly thick with a relatively small entrance hole, just large enough to receive the crab. A typical one measured an inch and a half in height and was slightly wider, outside dimensions. On the whole, these shelters bear far more resemblance to the shelters of Group 5 crabs than to the structures of *U. minax* (Group 2). About half the displaying males had shelters.

Breeding: No ovigerous females were seen or taken in late August when the collection was made, although the males showed more display activity than did those of the other species.

Affinities: This crab seems to be most closely allied to *coloradensis*, known only from near the head of the Gulf of California. The new form differs from this species in having the front only about two-thirds as wide, a stronger oblique ridge on the inner surface of the major palm, with the individual tubercles rounder and more isolated, and with the two tuberculated ridges at base of dactyl moderately divergent, instead of parallel. Both in its physical characteristics and in the rapping form of its display, this crab belongs clearly in the series I have designated (1941, p. 166) as Group 4. As in *coloradensis*, however, the relatively high development of the spoon-tipped hairs on the merus of the second maxilliped, of the arm of the abdominal appendage, and of the teeth on the suborbital margin, as well as the less rounded carapace and less specialized pollex of the major cheliped, all show that the proposed new species is a primitive member of its group, compared with the end forms, *batuenta* and *saltitanta*. The display, with the rapping phase occurring only at moments of excitement, instead of throughout display, is also primitive in character; unfortunately I have as yet had no opportunity of observing the display of *coloradensis*; the comparison should prove interest-

ing. This new species is the first of its group which has been observed to build a shelter, and the first time a member of the group has been reported from the Atlantic coast. The building of the primitive shelter may perhaps indicate the basic, ancestral affinities of this group with the typical shelter-builders—*beebei*, *latimanus* and *terpsichores*—of Group 5.

Range: Known only from Pedernales, Venezuela.

Local Distribution: The 64 specimens were found on several sandy-mud or muddy beaches in the immediate vicinity of Pedernales (i.e., from the beach at Pedernales itself, from Tapure, and from the shore of Cotorra Island), always completely in the open, but fairly near mangroves.

Material: Male holotype: Cat. no. 42423, Pedernales, Venezuela; 7 males and 6 female paratypes, same locality; Cat. no. 42424; 38 additional males and 26 additional females, same locality, Cat. no. 42425.

The name *cumulanta* is given in reference to this crab's habit of heaping up mud.

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EXPLANATION OF THE PLATE.

PLATE I.

- Fig. 1. *Uca murifecenta*. Male holotype (Cat. No. 42167), dorsal view. Carapace length 14.5 mm.
- Fig. 2. *Uca murifecenta*. Major chela of holotype, inner view. $\times 2.4$.
- Fig. 3. *Uca cumulanta*. Male holotype (Cat. No. 42423), dorsal view. Carapace length 8.4 mm.
- Fig. 4. *Uca cumulanta*. Major chela of holotype, inner view. $\times 4.3$.



FIG. 1.



FIG. 2.

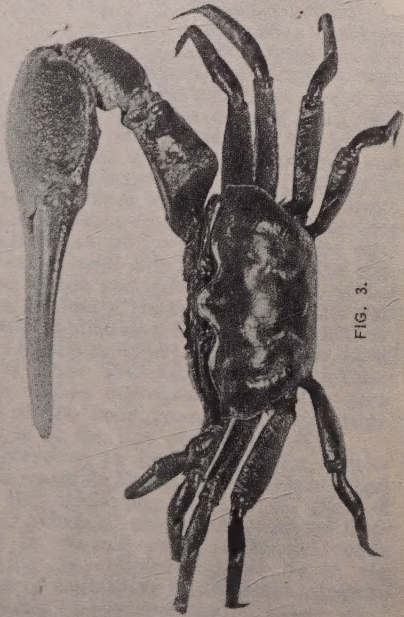


FIG. 3.

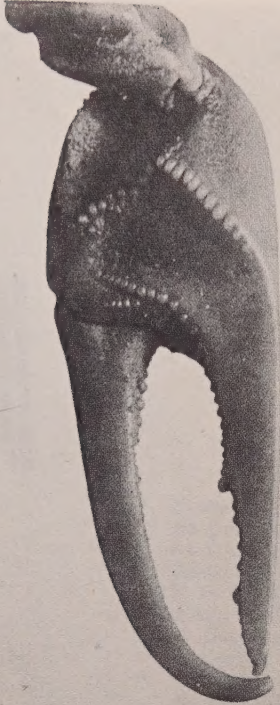


FIG. 4.

CRABS OF THE GENUS UCA FROM VENEZUELA.

